SOLAR MASS CLUMPS IN THE B5 CORE

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Results from IRAS have shown that four compact sources exist within the central 0.°5 of the dark cloud Barnard 5 (B5) (Beichman *et al.*,1984, *Ap. J. (Letters)*,**278**, L45). The source denoted IRS1 by those authors is the only IRAS source located within the core (~ 5' x 10'). IRS1 appears pointlike in all bands except the 100 μm band. The NH_3 maps of B5 (Benson, 1984, Ph.D thesis; Benson and Myers 1988, private communication) show two peaks of emission in the core of B5. The southernmost of the two peaks in NH_3 emission corresponds to the location of the IRAS source while the northern peak, located approximately 2' north of IRS1, has no IRAS counterpart. Boss (1985, **ApJLett**,**288**, L25) suggested that a second protostellar source could be present at the position of the northern NH_3 peak based on his models of binary protostellar formation. We report observations of the B5 core at 160 and 360 μm which were made in order to test Boss' hypothesis and to further study the environment of a known star forming region. The 360 μm observations were made at the NASA Infrared Telescope Facility and the 160 μm observations were made from the Kuiper Airborne Observatory using the University of Chicago submillimeter 32 detector array camera and Far-IR 32 detector array camera. Figures 1 and 2 are photometric maps of the B5 core at 360 and 160 μm, respectively, made using a 45" beam. In figure 1, contour levels represent 1Jy/beam with the peak contour being 9 Jy/beam. In figure 2, contour levels represent 1.2 Jy/beam with the highest contour level at 10.8 Jy/beam. The (0,0) position corresponds to $\alpha(1950) = 03^h44^m28.^s7$ and $\delta(1950) = 32°44'30''$. Both maps display a crescent shaped feature similar to that seen in the outer regions of B5 in the $C^{18}O$ observations (Goldsmith, Langer, and Wilson, 1986,*Ap. J. (Letters)* ,**303** , L11) (GLW). The NH_3 map (Benson and Myers, 1988) correlates much better with the 160 μm map than with the 360 μm map. Four regions of relatively high density are observed along the crescent ridge, which we have labelled A, B, C, and D. Region A corresponds to the position of the IRAS (IRS1) point. Regions B and C have not been previously identified, while D corresponds to the northernmost NH_3 peak. The background flux from the ridge is ~ 4 JY/beam at 360 μm and ~ 3 JY/beam at 160 μm. After background subtraction and beam deconvolution, both A and B appeared approximately gaussian in shape with FWHM values of 44" and 32", respectively, at 360 μm. The total flux densities for A and B at 360 μm are 12 Jy and 5 Jy, respectively, and total flux densities at 160 μm for A and B are 16 Jy and $\leq$1.5 Jy.

To summarize:

1) The intensity of the ridge area (figures 1 and 2) is consistent with heating by the interstellar radiation field (ISRF), which has a total intensity of $\sim 2\text{x}10^{-6}$ $\text{Wm}^2\text{sr}^{-1}$, as calculated by Mathis, Metzger, and Panagia (1983,*Astr. Ap.*, **128**, 212). The 360 μm map also indicates a total gas mass of $50M_o$ which agrees very well with the result from the $C^{18}O$ observations by GLW. This mass is far greater than the Jeans Mass of the core, which, in the absence of significant magnetic and rotational support, will lead to gravitational instablility and fragmentation.

2) The broad spectrum of clump A (not shown) implies the presence of more than one component. For wavelengths $\leq$ 100 μm, a hot component ($\geq$ 50K) dominates the spectrum. IRAS measurements have determined a total luminosity ($\lambda \leq$ 100 μm) of $\sim 8L_o$ for this

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component Beichman *et al.*, 1984). A colder component ($\sim$ 15K) dominates the spectrum at wavelengths longer than 100 μm.

3) The ISRF is insufficient to explain the heating of the cold component, however, our results are consistent with additional heating from the nearby source IRS1. Perhaps more intriguing is the possibility that the cold component is associated with the small disk-like structure around IRS1 recently seen in HCN by Fuller (reported elsewhere in these proceedings). The number density ($2 \times 10^5 cm^{-3}$) and visual extinction (A_v=26) values calculated from the continuum data given here agree very well with the number density implied by the HCN measurements of Fuller and the A_v value derived from near infrared measurements of IRS1 by Myers (private communication).

4) Clump B appears at 360 μm but not at 160 μm, implying a low dust temperature ($\leq$ 11K). Taken together, the temperature estimate from the 360 and 160 μm maps and the intensity measured from the 360 μm map, imply a mass of $\sim$3$M_\odot$, and are consistent with heating by the ISRF. Clump B appears to be gravitationally unstable based on our measurements which imply that it has a Jeans Mass of only 0.6$M_\odot$. Clump B is, therefore, indicative of the earliest stages of star formation, where fragmentation and isothermal contraction are occuring.

5) Although NH_3 is generally a good tracer of cold ($\sim$10K) dust, in regions of protostellar formation (such as B5) where temperatures can be $\leq$10K, submillimeter observations can reveal information about very cold dust that NH_3 observations would miss. This is evidenced by the fact that the NH_3 map of B5 correlates much better with the 160 μm map than with the 360 μm map.

6) Although our observations suggest a density clump in region D, these results cannot definitively answer the original hypothesis by Boss which predicted the presence of a second protostellar source in the B5 core at the location of the northernmost NH_3 peak. However, these observations have revealed additional clumps which are possible protostellar objects (most notably clump B), a result which is entirely consistent with Boss' theoretical models of fragmentation (Boss, private communication).

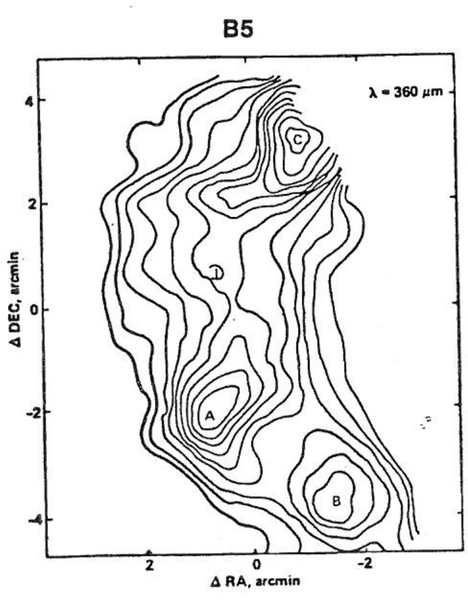

Fig. 1

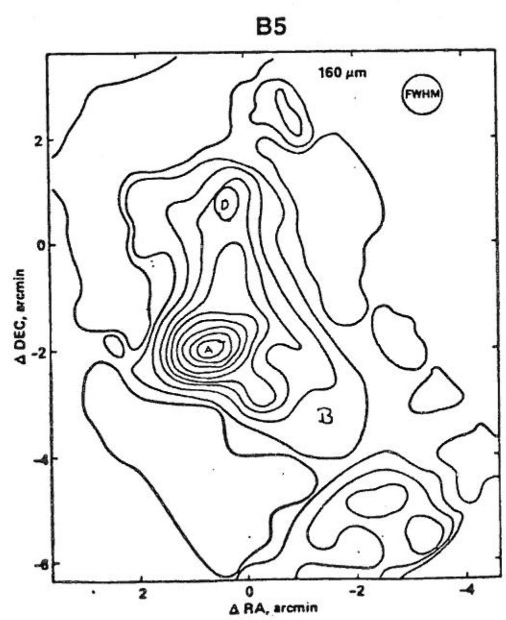

Fig. 2